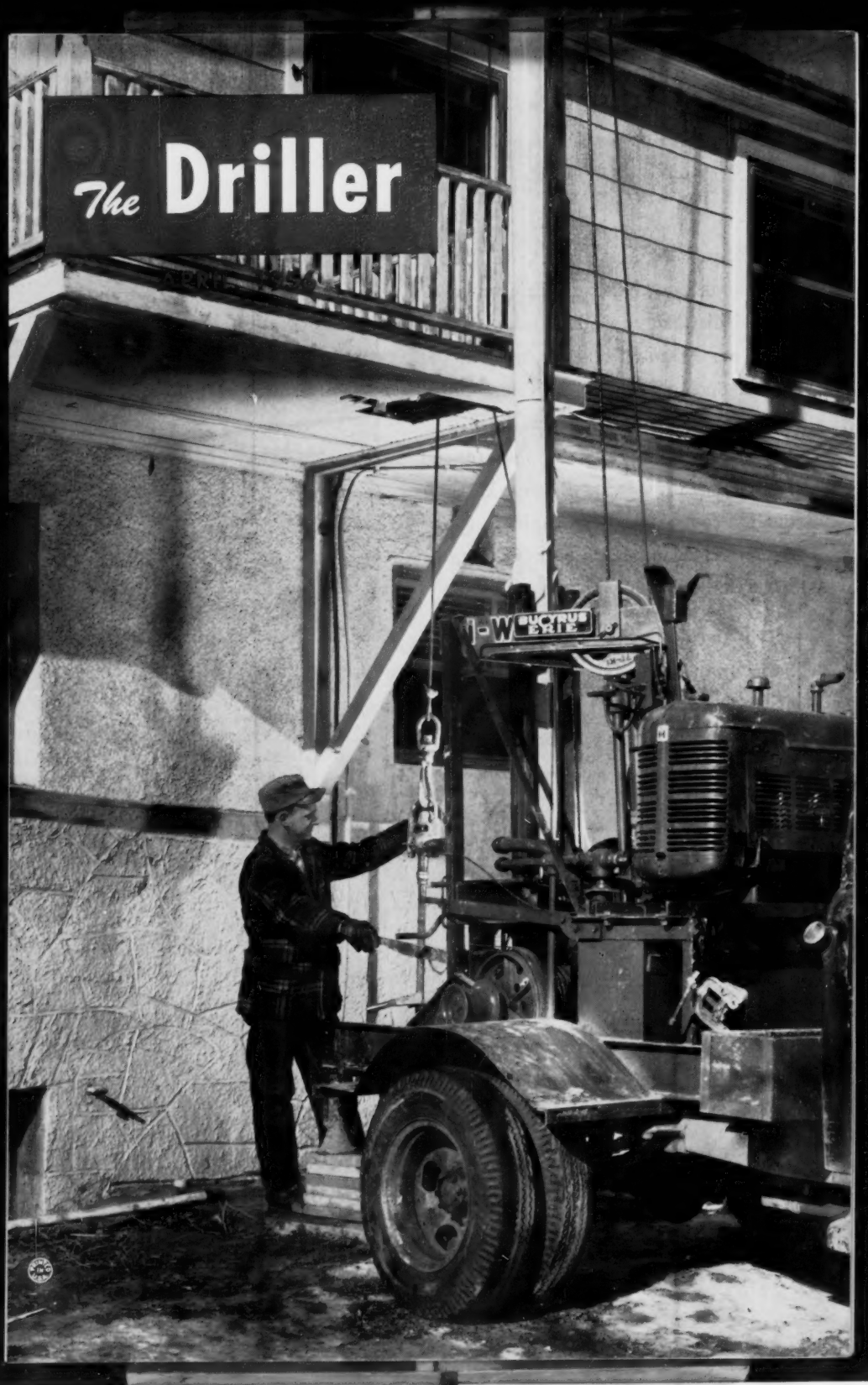
The Driller
I-W
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The Driller

Vol. 30 No. 4

April 1956

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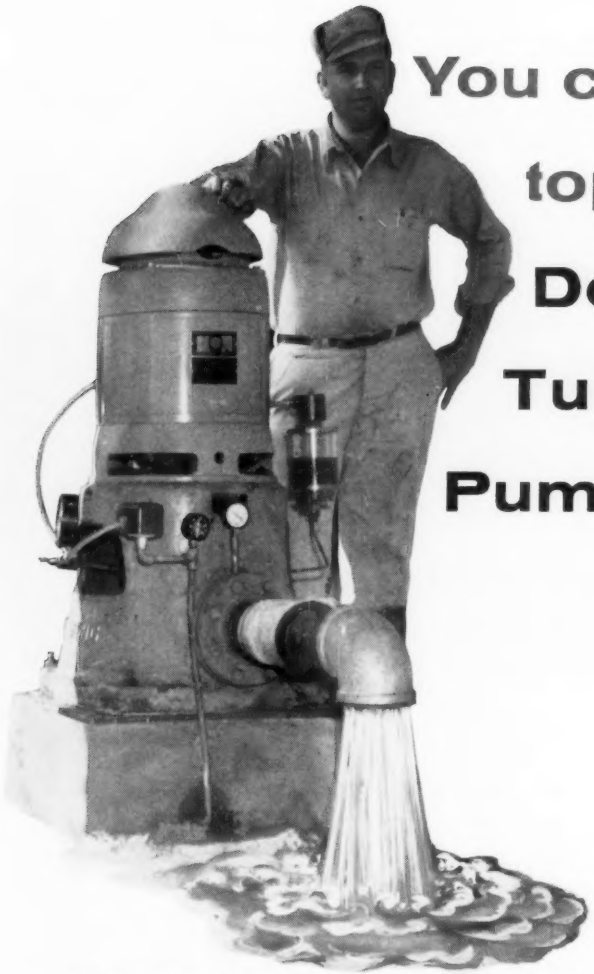

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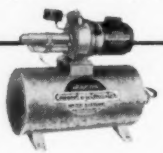
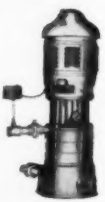
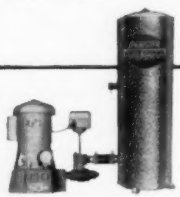


Convert-o-jetmaster



Single stage jetmaster



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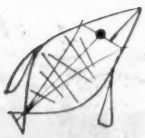

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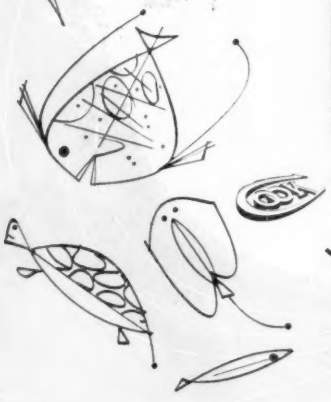

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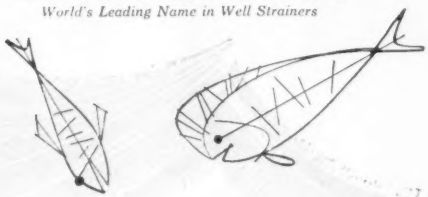

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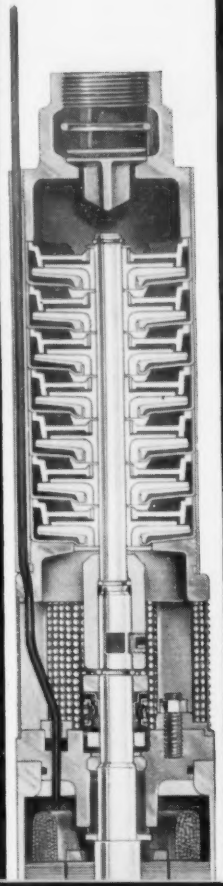

**MR. DRILLER** — Your job is not over which drillers everywhere have been

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In a word, here's a submersible that will do justice to the best well you can drill. Install the Rapidayton Dolphin for greater profit and greater customer satisfaction. Write for catalog.

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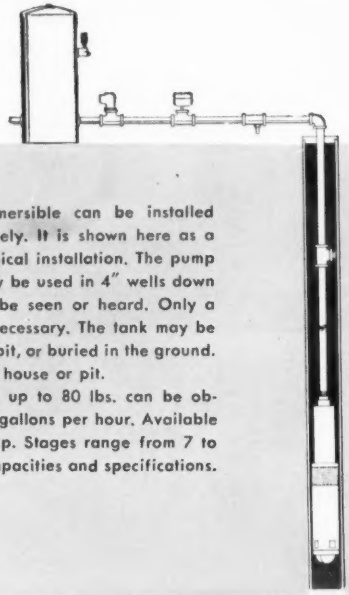

The Rapidayton Dolphin submersible can be installed easily, quickly, and inexpensively. It is shown here as a complete water system in a typical installation. The pump is down in the well casing (may be used in 4" wells down to 500 feet), where it cannot be seen or heard. Only a reasonably straight casing is necessary. The tank may be installed in the basement, well pit, or buried in the ground. No need for a frost-free pump house or pit.

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# He Got Tired of Winter

J. P. Carroll left winter behind 30 years ago. In an American winter playground, West Palm Beach, Fla., he built a thriving business. Today the firm owns seven rigs and employs 24 people.

IN 1925, J. P. Carroll had a comfortable job in Pittsburgh representing a major manufacturer. Like most northerners, he despised winter. Like most Americans, he thought it would be nice to go into business for himself. His feelings finally got the best of him. In December, as the snow and ice appeared, he took steps to prove that he could get along fine without them. He gave up his job and headed for Florida.

In those days, he was practically a pioneer in the Florida trek. He's never been sorry. Early in 1926 he established a well drilling and pump business at West Palm Beach. Today that business employs 24 people year round and drills 15 to 18 wells per week. Seven rigs keep busy filling orders. An attractive new shop, show room and yard make up the company headquarters on West Palm Beach's, main street: Dixie Highway (U.S. 1) — also one of America's main streets.

Intelligent, hard-working management and a wanted product have brought success to Carroll. The management in Carroll's case is a family affair. Co-partners are J. P. and N. H., or Mr. and Mrs. Carroll. Eventual head man of the business is their son,

**J. P. Carroll** built this establishment on the main street in West Palm Beach, Fla.

**J. P. Carroll looks** at one of the many swimming pool wells his firm has put down in the area. These jobs consist of two wells: one a salt water producer, the other a drainage well. Each well goes down past the fresh water aquifer.

Jack. One reason they've succeeded is that each thinks the other is the most important member of the team.

Without our asking, Mrs. C thought Jack should be played up in our story and Mr. C thought Mrs. C should get the spotlight. Jack, in turn, thought his dad merited the most attention. Mrs. C thought her two men were so much more important than she that she wouldn't even let us take a picture of her. How can a business fail with a spirit like that?

Demand for the firm's products — water wells, pumps and irrigation systems — has grown with each passing year. The reason: satisfied customers. The firm employs no salesmen, yet enough repeat and word-of-mouth business walks in the front door to keep the big crew busy.

Carroll puts down swimming pool wells, irrigation wells, home water

**Jack Carroll,** son of owner J. P., looks on while the firm's 1-W drills a well.

**With drive clamps** bolted onto the stem of this 21-W, these J. P. Carroll drillers drive casing into the ground on a job for a large home in a nearby suburb.

wells, air conditioning wells and once he sunk an elevator well (more on that later). The firm sells, installs and services Deming and Goulds pumps and water systems.

In Palm Beach and West Palm Beach the summers are hot and the struggle to keep foliage and grass attractively green for the winter trade is continuous. Out of this need has come one of Carroll's main enterprises, the construction of irrigation systems for home, hotel and farm.

Another Carroll specialty is the drilling of salt water wells. These are in demand to supply salty swimming water to prosperous Palm Beach citizens owning swimming pools. Formerly these pools were filled by pipelines stretching into the ocean. The lines were often victims of summer storms.

It was found that a less troublesome way to get salt water was to drill a well to the salt water table. For those who like their salt water swim, the well water is just as salty as that drawn from the Atlantic.

This type of well now provides one of Carroll's main markets. Each swimming pool requires two salt water wells. One is a supply well and the other is a discharge or drain well. When Carroll gets one of these orders, he moves his rig in and puts down two wells. One will be slightly shallower than the other. The depth, however, has nothing to do with its eventual purpose. The selection of the supply well is based solely on

**Jack Carroll scoops** out a handful of seashells from sediment in the portable mud-pit. Formation formed a 25-ft. bed.

performance. Whichever well produces the most water with the least drawdown becomes the water source. The other is used to receive the water when the pool is drained.

It should be pointed out that the ground is not saturated with salt water. The salt water appears in a definite table. And to reach it you have to pass the fresh water table.

One of Carroll's rigs, a Bucyrus-Erie 21-W, was hard at work on swimming pool wells when *The Driller* visited the contractor. In the rear yard of an ocean-front estate known as Southgate, the two-man crew was sinking two 6-in. wells to supply a swimming pool which was in the excavation stage. The first well was down 88 feet and the bit had gone through several rock lenses but had not yet reached the rock strata in which the well would be seated. Carroll expected to drill the wells to 100- and 150-ft. depths and then choose the supply well and the drain well. Later Carroll's crew would case these wells with corrosion-resistant galvanized pipe.

Though salt water wells may sound more glamorous, fresh-water wells provide the Carroll firm with its bread-and-butter trade. The crews drill them by various methods, for various purposes, to various depths and diameters.

In their West Palm Beach territory, the deepest well the Carrolls

**Young Jack Carroll** watches one of the company drillers put down hole with the newest addition to the J. P. Carroll fleet of drilling machines, a 1-W rig.

drill will be in the 300-ft. range. Diameters start at 2 inches, and the largest well they drilled was 24 inches in diameter.

Most of their wells and all of them on the west side of town require screens. Extensive underground formations of sand and shells make screens necessary. The company uses Johnson screens in several compositions — stainless steel, monel, and silica brass.

struction, the Meadow Park Elementary School. Center of action was the newest member of the Carroll line, the Bucyrus-Erie Model 1-W water well drill. This is a versatile unit designed for drilling by any one of four different methods: cable tool, jetting, rotary and hollow rod. In the short time the firm has owned the rig, they have used all of the methods except the hollow rod.

To put in the school well, the Car-

**Set up and ready** to begin drilling, the J. P. Carroll drilling crew prepares to drill a water well for a school under construction near West Palm Beach.

A typical well goes through several strata of rock to a 40-ft. deep rock formation. The casing is seated 5 or 6 feet into the comparatively soft rock. There are, of course, endless exceptions to this pattern.

Some of the exceptions came to light on one of Carroll's jobs which *The Driller* visited. At the western edge of West Palm Beach, Jack Carroll and driller Dick Meyers were drilling a well for a school under con-

rolls had to drill three wells and use two of the 1-W's drilling methods. To begin, they drove a 2-in. well point to a depth of 30 feet. This inexpensive well was driven to give the building contractor a source of water for his concrete and to supply drill water for the rotary method.

Then a well was jetted to 82 feet to sample the underground table. Finally the permanent 6-in. well was put down by the rotary method. They had

**One of the larger** installations put in by the J. P. Carroll company is this pump house and storage tank. This set-up supplies an entire subdivision's water needs.

the well down to 100 feet and had tested it at 250 gpm. This would be the completed well after casing and screening.

In reaching this depth, the crew had run into challenging problems. They made the first 50 feet of well by driving the casing down that far. From there on they rotated inside the casing, because of unstable soil conditions. When they reached the 80-ft. depth, they encountered a 25-ft. thick bed of solid sea shells. The shells were probably deposited there millions of years ago by an ancient ocean. They were no help to modern-day drillers because the drilling mud would not

*(Continued on page 54)*

**Here is a close-up** of the portable mud-pit used in conjunction with the firm's Bucyrus-Erie 1-W. It was made by cutting a 525-gal. tank in half lengthwise.

**Derricks in the Sagebrush: Part IV**

# The Return of Bert Perry

Bert Perry is an Idahoan who came from Arizona to drill Bureau of Reclamation water wells.

*by Ray Day*

OF all the drillers who have punched holes down through broken basalt beneath the Bureau of Reclamation's Northside Pumping Division of the Minidoka Project, perhaps none has more of a grass-roots' tie than Bert Perry of Rupert. Perry was born in southern Idaho, not far from Rupert, at Gooding. His father, George F. Perry, drilled wells in that vicinity as far back as 1912. After moving to Mesa, Ariz., following World War II, during which time he was in the well-drilling business with his father, Bert Perry came back to Idaho. To him it's home.

Perry's interest as a driller in the Northside Pumping Division water development program is clearly apparent. He has taken very little outside work. In the years since George F. Perry & Son first began bidding this work, the firm has concentrated

**Driller Bert Perry** uses his share of heavy tools. Here he poses beside one of the bits a 25-in. diameter job he uses on the tool string of his 24-L.

**Perry mans** his Bucyrus-Erie 24-L alone on an irrigation well in the Idaho desert.

strictly on government irrigation wells. A year ago, Perry's father retired from the company. Now that he is on his own, Bert Perry continues to concentrate on Government work so far as southern Idaho is concerned. One of his machines is still down in Arizona, but the other — a Bucyrus-Erie 24-L — is very much in evidence on the Northside Project.

Perry first began to place successful bids with the Bureau of Reclamation in 1951, when his bid was low for 13 observation wells scattered over the project site. In 1954, another successful bid was placed for seven 20-in. holes. The 1955 program included nine wells: seven are 20-in. holes and range from 255 to 325 feet deep, and two are 25 inches and range from 265 to 325 feet.

Although Perry is drilling some of the hardest formations in the Northside Project, his 24-L is punching the 20-in. holes down in good shape.

Bert Perry was born a well driller, and his interest in the fascinating business never has waned. Even today when he is perhaps as familiar with the soil and rock formations in the Minidoka Project area as any other driller, Perry retains a curious, inquisitive attitude about everything beneath the ground. The well on which his 24-L was set up when *The Driller* visited the job showed a peculiar tendency to blow and suck during the same three to four hour period, which is something no other well in the area had ever done. Even while he was trying to figure that one out, his mind was busy with the theory of drilling line resonance on extremely deep holes, and he wondered whether engineers ever would solve the mystery of how to make a drill bit hit twice on one stroke of the beam.

The same experimental turn of mind let Perry come up recently with a successful method for building up the end of a large-diameter drill bit while it was hanging on the drill line. By using a small rectangular piece of rolled brass plate which he holds just under the outside edge of the bit,

**This is the rope** centering device used by Bert Perry. It steadies the drill rope and gives a fast visual answer to whether the bit is running off the center.

Perry is able to build a bit up with square corners. His wide experience also enables him to flatten those corners down to about ten degrees of curve, using the same brass plate if he so desires. He uses a little softer rod than some of the other drillers on the project use, but feels it has more resiliency under shock, and therefore does not break out quite as bad as some of the other rods.

If all factors are considered, Perry has set some excellent performance records on the Northside Pumping Project with his 24-L.

On one of his 20-in. wells, drilled in 1954 to a depth of 226 feet, he averaged 14 feet per 12-hour day and finished the well successfully, with no shooting, to within seven-sixteenths of an inch of true plumb. In one brutal spot, which was much more difficult, he also admits that it took 12 shifts to get 35 feet in a badly caving tough-to-drill formation. He is the type of driller who takes the breaks as they come, and if a caving hole hangs up a heavy bit, he doesn't get excited. As a matter of fact, that occurred while the notes for this piece were being made. Perry tried a light bumper which didn't work. He borrowed a heavier bumper from another driller and soon released his tool string.

Fishing is nothing new to Perry. According to him, it's something that a driller can reasonably expect when he works with heavy, large-diameter tools in caving formations. He recalls ruefully one tough fishing job which he and his father worked on in Arizona. A set of drilling tools was lost at 480 feet because the upper end of a set of jars had split.

With a set of jar grabs on his fishing line, Perry reached down thinking

that it would be easy to pick up the tool string by hooking the bottom half of the jars. The tool string, however, had rolled part way over in the big caving hole at the bottom. After considerable fishing, the jars finally were hooked and the tool string was started out. Well up toward the ground surface, the jar steel tore apart, turning the tools loose to plunge again toward the bottom of the well. Halfway down the drill bit hit a rock ledge, the pin snapped off the bit, the stem passed the bit, and the entire string plunged in a jumbled mess to the bottom of the well. After considerably more fishing, Perry decided that the drill stem and jars were in the bottom of the hole with the drill bit lying on top. His guess turned out right, and it was the first and only time in all his experience that a fishing job ended by getting the bit out first.

Possibly his first fishing job on the Bureau of Reclamation project has been the recovery of a 20-in. bit which broke off at the shoulder. It was a star-type bit, and at the time the breakage occurred, stiffening webs had not been welded between the vertical fins on the bit steel. Had the bit been equipped as Perry's bits are today, the fishing job might not have been nearly so difficult. As it was, however, it took a considerable amount of time with an 18-in. friction socket before the heavy piece of iron was picked up and brought to the top of the ground.

Perry operates his 24-L alone. He tries to leave home in Rupert not later than 6:15 each morning. As he goes out to the job he carries with him two portable water tanks which fit in the back of his pickup truck. Together these tanks hold approximately 500 gallons, or enough to do a day's drilling. Perry doesn't hesitate to use water, especially when bedded planes of basalt rock intersect with each other and a drill bit starts to run. He has often found that loading a hole with water in caving formations will cause material to run to the low side, often furnishing enough temporary resistance so that the bit will break up the harder material on the opposite side of the hole. If the water scheme fails to work, Perry

**Perry ran into** a little fishing job here. Caving material underground slipped in and trapped the tool string. He hooks on a bumper to try to jar it free.

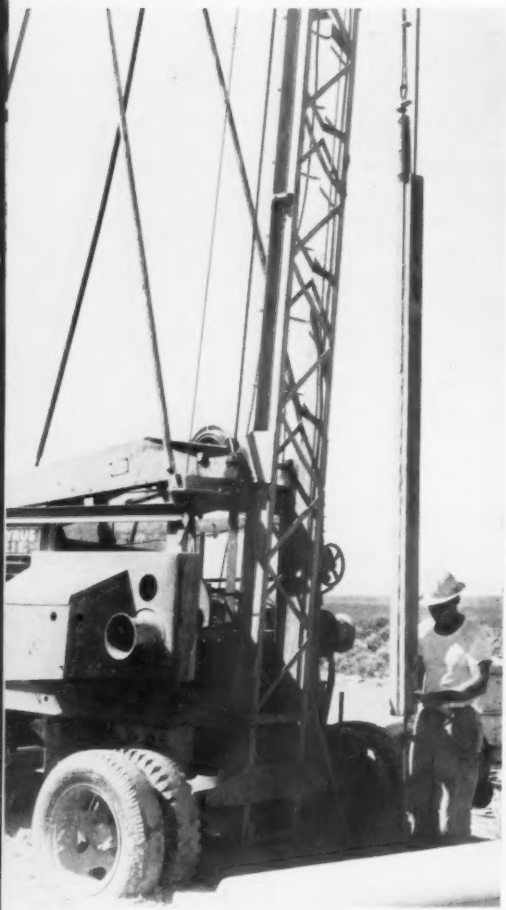
likes to use a piece or two of scrap steel or scrap iron, which he drops into the hole by gravity. This, too, will work to the low side and furnish enough resistance to the drill bit so that the hard rock on the other side of the hole will be cut. Perry still grins as he recalls one day in Arizona when his father, faced with a similar problem, found a piece of steel chain which he dropped in the well hole.

"It took him three days to drill through that chain," Perry smiled, "but dad always said it was worth it. He had never seen a well hole straightened up so beautifully."

If the water or scrap-steel method fails to work, Perry will use powder. Of all the drillers on the Northside Project, Perry probably favors powder less than any other man. Too much powder, he believes, will loosen most formations. On the basalt rock of southern Idaho, however, the rock has a curious tendency to absorb most of the explosion within a very short distance, so that no excessive shattering has resulted. Under most conditions, where a charge of powder will help straighten a hole out in about 30 minutes, Perry will use it. If the slope of a changing rock layer is sufficiently gentle, however, or if caving material is present, he favors water.

When Perry first came up to southern Idaho to drill the observation wells in 1951, USBR specifications were considerably more lenient than they are today. All that was necessary regarding the plumbness of the well was that the drill line not touch the side at any point from the bottom to the top. Today, USBR specifications allow a deviation of only one and one-half inches from true plumb in the well's entire length. According to Perry, it is easier to make good footage under those specifications than it is under specifications which allow more crookedness in the hole.

Perry checks his well at least every two feet for perfect plumb, then uses whatever corrective measures are necessary promptly — water, scrap iron or explosives. According to Perry,



**Perry attaches** a heavier bumper to the tool string after a lighter one failed to dislodge a bit stuck in the hole. This one weighs approximately 800 pounds.

**Drilling alone** with his 24-L, Perry puts down a Bureau of Reclamation well in the desert. Here he pours a bucket of water into the 25-in. diameter hole.

the straight hole will drill sufficiently easier to make up for the lost time.

Perry says that he is extremely well pleased with his drilling equipment, with the type of well drilling being done by the U. S. government in southern Idaho, and by the high degree of cooperation which exists between competing well drillers in the area. They borrow tools from each other, even drive out of their way to offer help when one of their competitors gets into trouble.

Perry expected the lenient completion time in Bureau of Reclamation specifications, coupled with the high performance capacity of his 24-L, to permit him to discontinue drilling operations during the period of extreme cold weather and allow him to seek the sunshine offered in Arizona. He followed that idea the previous winter and it worked fine. If he did go seeking sunshine, the first warm days of spring will see him again rolling through the sagebrush roads in his pickup heading toward his 24-L for another 12-hour drilling shift.

# News of the month

## Pump Problems Discussed At Turbine Group Meeting

The Vertical Turbine Pump Association held its first tri-annual meeting of 1956 in Phoenix, Ariz., on Jan. 30 and 31.

The members reviewed industry problems and legislative, technical and marketing developments. Dr. H. J. Thiele, consulting hydrologist, gave a talk on "The Pump Industry and Ground-Water Development Forecasts." He told the pump industry that by following underground structures they could show what ultimate limits were in water production for the future.

## New Booklet Available On Soft Water Benefits

A new booklet describing the benefits of soft water is available from The F. E. Meyers & Bro. Co., Ashland, Ohio.

Titled "Let The Short Billed Workin' Bird Make Your Work Easier," the book describes the various ways that soft water can be used to advantage for laundry, housecleaning and personal cleanliness. It also tells how the householder can obtain a free test of his water supply.

## New Sizes Added to U.S. Electric Gear Drive Line

An increase in available sizes of Holloshaft right-angle gear drives has been announced by U. S. Electrical Motors Inc. Sizes now range from 11 to 150 hp. They are adaptable to any vertical turbine pump and are driven by gas, gasoline or diesel engine. According to the manufacturer, Holloshaft gear drive permits the pump shaft to be mounted integrally, assuring efficiency and precise adjustment of pump impellers.

This drive features reverse protection clutch, heat-treated castings, weatherproof construction and automatic oil circulation.

For further information write U. S. Electrical Motors Inc., Box 2058, Terminal Annex, Los Angeles 54, Calif.

## Promotions Announced by The Tait Mfg. Co.

Frank G. Hickey, Jr., has been made general sales manager in charge of all domestic and foreign sales of The Tait Mfg. Co., Dayton, Ohio.

Other promotions include James F. Pease, named product sales manager; Melville Sorrell, marketing manager; and Brand Laseter, field sales manager.

## Parkhurst Added to N. J. Examining Board

Marvin L. Parkhurst, Verona, N. J., has been added to the New Jersey Examining Board of Well Drillers.

The board examines applicants for well drillers' licenses and processes well permits.

Parkhurst is a driller with 16 years' experience in water well drilling and contracting. He is a member of the National Water Well Association and has served as its regional director. He

# Amazing new electronic "inspector" detects slightest imperfections in wire rope

This new inspection machine literally "sees through" wire rope and detects any imperfections that may occur in the manufacturing process. It inspects every inch of rope, 360° around, and *all the way through!* If an imperfection occurs, the machine instantly records it on a chart, squirts paint on the rope, lights a light and alerts operator to correct the flaw.

In the preliminary tests using wire rope containing specimen broken wires, the electronic "inspector" proved 100% effective. It didn't miss one. These tests prove to us that this device will give the regular inspector a superior tool which will work continuously and will "see" all.

To our knowledge, American Steel and Wire Division is the first wire rope manufacturer to recognize the possibilities of this electronic inspection device as an *extra* step in quality control that will assure better, more uniform wire rope and lower costs to the user.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL
GENERAL OFFICES: CLEVELAND, OHIO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

**USS AMERICAN TIGER BRAND WIRE ROPE**

*Excellay Preformed*

USS

UNITED STATES STEEL

is also a member of the New Jersey Water Well Contractors Association and served two terms as its secretary.

## New Wire Rope Circular Available from Macwhyte

A circular covering new specifications and information regarding proper use of plastic coated wire rope is available from Macwhyte Co., Kenosha, Wis.

Specifications for plastic coated wire ropes having strengths from 480 to 7,000 pounds, weighing from 13 to 153 pounds per 1,000 feet, are shown. Minimum safety factors, sheave and drum diameters and tread pressure formulas are also included.

The circular, No. 5610, is available free by card or letter sent to local distributors or to Macwhyte Co.

## Lancaster Announces New Submersible

Lancaster Pump and Mfg. Co., Inc., has announced a new ⅓-hp submersible. Called the 7007-X, the model is designed for 40 to 60-ft. water levels. It features all bronze construction with a stainless steel shaft and water lubricated capacitor motor. Complete details are available on request.

## New Catalog Issued By the Tait Mfg. Co.

A new catalog, showing the complete line of Rapidayton water appliances, has been issued by The Tait Mfg. Co. (formerly Dayton Pump), Dayton, Ohio.

The 36-page catalog shows Rapidayton jet, reciprocating and submersible pumps and water systems; manual and automatic water softeners, and upright and submersible cellar drainers.

## Big Towns Served By Wells on Increase

Communities of 25,000 population and over which obtain water supplies from ground sources have increased from 91 in 1948 to 129 in 1955, according to a report issued by the Public Health Service.

In 1955, communities in the 25,000-and-above category getting water from the ground accounted for 22.6% of the total. This represents a total population of over 11 million being served with a public water supply obtained from the ground, as compared with only 6.8 million in 1948.

## Solution Offered to Develop, Clean Wells

A solution for cleaning old wells and developing new ones has been announced by Industrial Chemicals, Inc., South Bend, Ind.

Called Well-Kleen, the solution was developed in conjunction with Edward E. Johnson, Inc., St. Paul,

"We've been in business a long time."

# Quick Change 1-W Drill

## Boosts Small Hole Profits

Bucyrus-Erie's versatile 1-W drill assures top profit margins on small diameter water wells. It's designed and built for QUICK-CHANGE performance. For example, you can do as this driller has done — change over in less than an hour from a string of hollow rods to rock-eating cable tools. He might have switched just as easily to jetting tools or to a special rotary attachment. Speed and convenience in changing drilling methods are the keynote of the 1-W.

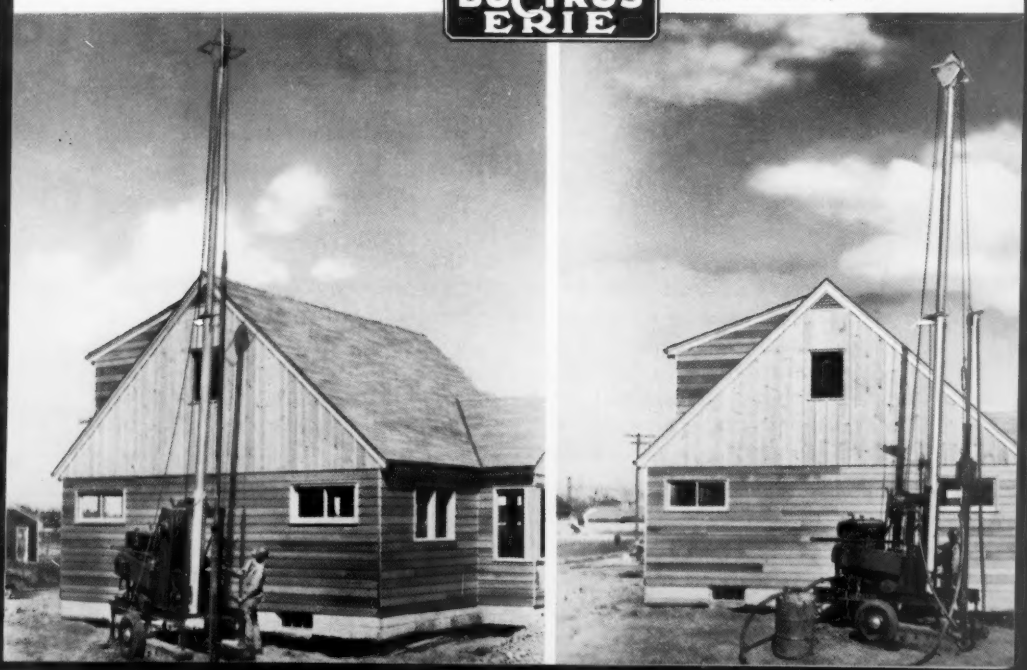
Setups are fast and simple, requiring as little as 10 minutes for hollow rod or jetting, 30 minutes for rotary, and an hour or less for cable tool. You can switch from cable tool to rotary in 30 minutes.

For on-the-spot selection of best drilling method, consider this money-saving QUICK-CHANGE drill. To get complete details, write us today or call on the Bucyrus-Erie drill distributor in your area.

62W56C

*First with the Finest in Water Well Drills*

BUCYRUS ERIE South Milwaukee, Wis.



Minn. According to the manufacturer, the solution removes lime, iron, clay, silt and other encrustants from the well screen and from the surrounding area.

Development of a well with the solution can be handled either by surging with a plunger or by introducing a jet stream, cleaning by using the pump installed on the well.

For full information, write Industrial Chemicals, Inc., 2215 S. Main St., South Bend, Ind.

## Ground Water Described In Central Kansas Area

A report prepared by the Kansas and Federal Geological Surveys reveals that moderate to large supplies of water can be obtained from wells penetrating the rocks in Reno County in central Kansas.

The rocks that crop out in the county are sedimentary. The oldest formation is the Ninnescah shale, which is exposed principally in the southern part of the county in the valley of the Ninnescah River. Except for this area and small outcrops of rocks in northeastern Reno County, the county is underlain by Pleistocene deposits that represent all four of the major glacial stages.

All public, industrial, and irrigation and most domestic supplies are obtained from wells in the Pleistocene deposits. The water is generally hard but otherwise suitable for most purposes, except in local areas where the iron or nitrate content is such as to be objectionable or contamination has rendered the water salty. Only meager supplies of highly mineralized water are available from the Permian rocks.

Pending publication as a bulletin of the State Geological Survey of Kansas, typewritten copies of the report may be consulted in offices of the Geological Survey at Room 1242-G, General Services Bldg., 18th and F Sts., NW., Washington, D.C., and Room 111, Lindley Hall, University of Kansas, Lawrence, Kans.; the Division of Water Resources, State Board of Agriculture, Topeka; and the Division of Sanitation, State Board of Health, Marvin Hall, University of Kansas, Lawrence.

## Van-Cor Plastic Pipe Approved by NSF

Van-Cor plastic materials, made by Colonial Plastics Mfg. Co., Cleveland, have been approved by the National Sanitation Foundation for use in systems transporting drinking water.

The approval means that pipe and fittings are free from any toxicity or effect on taste.

Van-Cor materials include both chemically-resistant, normal-impact, and chemically-resistant, high-impact types. Pipe diameters range from ¼ through 12 inches.

Complete information is available from the company at 8007 Grand Ave., Cleveland 4, Ohio.

## New Centrifugal Line Offered by Decatur

The Decatur Pump Co., Decatur, Ill., has announced new ½-hp pumps for domestic water systems.

Capacities range from 1,000 gph at 5-ft. depth to 240 gph at 90 feet.

According to the company, pump parts are precision-machined from bronze, and units have a vent-air channel which allows any air that begins to collect near the impeller hub to

*(Continued on page 34)*

# "We've proved it 15,000 times"

## ...OUR NEW *Jacuzzi* DEEPRIME JET

**proved self-priming on 15,000 deep well installations**

*—— Candido Jacuzzi*

Here's proof! Jacuzzi's new patented Deeprime Jet assures trouble-free automatic water service as never before possible. That's because the Jacuzzi Deeprime Jet is the only deep well jet pump in the world that's self-priming. Won't lose prime on gaseous or low capacity wells. Reprimes automatically after electric power failure. Needs no lubricating or frost-proofing. Nothing else like it.

- Makes your well a satisfactory producer right off the bat. Sand, gaseous water, low capacity or changing water levels are no problem.
- Provides all that extra pressure needed for automatic washers, showers, lawn sprinklers.
- Assures satisfaction by practically eliminating need for service. Self-priming on wells to 400 feet. No motor or moving mechanism of any kind below ground to clog with sand or burn out if well gets pumped down.

*Jacuzzi*
FULLY AUTOMATIC
DEEPRIME JET
DEEP WELL WATER SYSTEM

***BE CHOOSEY RECOMMEND JACUZZI***

**Send for this free bulletin!**

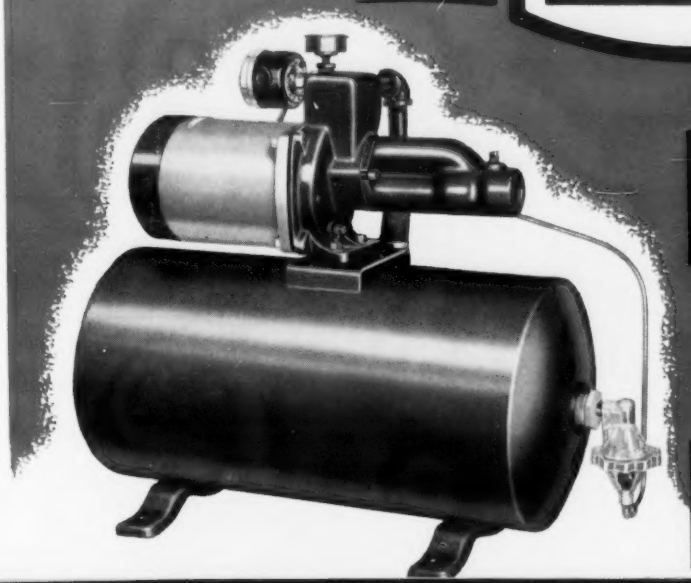
**JACUZZI BROS. INC.**
1 JACUZZI AVE. • RICHMOND, CALIF.
4101 BAYLESS AVE. • ST. LOUIS 23, MISSOURI

Please send bulletins on your new Deeprime Jet.

Name_____

Address_____

# Make Money 3 Ways with ONE STA-RITE Pump



**1**

SELL IT FOR SHALLOW WELLS

Need a shallow well pump? Simply attach this glass-lined jet and the job's made —up to 1325 GPH.

**2**

SELL IT FOR DEEP WELLS

Need a big lift? Set the

## NEW, THREE-WAY *Cosmopolitan* REDUCES INVENTORY, SIMPLIFIES INSTALLATION, PUMPS DEEPER!

WHERE IN THE WELL IS THE WATER? 10 feet? 30 feet? 120 feet? Hook up with the Three-Way Here's *one* pump that's *ideal* for shallow wells, *great* for deep wells, *best* convertible yet! It's designed for easy, modern selling. . .more profitable sales. All you need is a selection of ⅓ and ½ H.P pumps. Add glass-lined jets and you've got yourself a pump for *every* well in the 0-120-ft. range. Think what this does to inventory cost—installation time. Better yet, compare gallonage, and you'll agree—there's nothing like the Three-Way. Pumps available factory-assembled with full range of horizontal tanks, including exclusive, glass-lined tanks.

Well jets (glass-lined). Presto—down to 120 feet and *plenty* of water.

**3**

**SELL IT AS A CONVERTIBLE**

**Thrifty buyers want convertibles! Use this jet and you've got a sale. No conversion kit needed.**

### Your best bet for Month-of-May Promotion

Give your pump sales a *big lift* in profits and customer satisfaction—as only Sta-Rite delivers it. Feature this new Sta-Rite Three-Way during National Water Systems Month. We've got new sales-producing literature, displays, dealer helps to pave the way to sales. It's worth a call to your pump distributor to find out more. In the meantime, fill out coupon for **FREE** 48-page catalog.

MEMBER RUNNING WATER EVERYWHERE YOU NEED IT NAT'L ASSOC. DOMESTIC & FARM PUMP MFRS.

STA-RITE PRODUCTS, INC.
603 S. 8th Street, Delavan, Wisconsin
Please send me FREE 48-page Sta-Rite Catalog and price list.

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STA-RITE

**The Pumps with the Extra Profit . . . ask about it!**

STA-RITE PRODUCTS, INC., 603 S. 8th STREET, DELAVAN, WISCONSIN
CHAMBLEE, GA. • LOS ANGELES, CALIF.
IN CANADA: STA-RITE PUMPS (CANADA) LTD., AJAX, ONTARIO

### Ernest F. Buss

Ernest F. Buss, a driller who spent 53 years working with the Goldbeck Well Drilling Co. of Appleton, Wis., died in his sleep Aug. 26, 1955. He was 70.

Mr. Buss was active the day before he died, having checked two drilling jobs for the Goldbeck firm on that day. He saw the well drilling business go from steam to gasoline engine to truck-mounted rigs. Working entirely with cable tools, he often commented on the ease of drilling wells in later years with the aid of open side sockets, automatic feed, dart valve bailers, heavy tool strings, etc.

He is survived by three sisters and one brother.

*(Continued from page 30)*

bleed off to the discharge side of the pump to eliminate possible air-binding.

Further information is available on request from Decatur Pump Co., Decatur, Ill.

## New Bulletin Covers Water Leak Detector

A 20-page bulletin covering a device used in locating underground water leaks has been prepared by the Simplex Valve & Meter Co.

Called the Simplex Pitot Assembly, the device consists of a pitot rod, manometer and pitot recorder. The unit is used to locate hidden leaks in water mains.

Data on care of equipment, installation instructions, theory of operation and formulae is contained in the bulletin. For further information, write the company at 7 E. Orange St., Lancaster, Pa.

## Pleuger Submersible Adds to Sales Staff

The addition of two sales representatives to the sales staff of Pleuger Submersible Pumps, Inc., Lancaster, Pa., was announced by Alfred B. Krechtler, eastern sales manager.

They are Stanley A. Stark and Donald Scott.

Stark, who is a graduate mechanical engineer, brings 15 years' experience in the industrial and domestic pump field to his new post. He will represent the company in the northeast.

Scott joins the Pleuger organization with five years' experience in the industrial and domestic pump industry. He will represent the firm in the midwest and plans to reside in Madison, Wis.

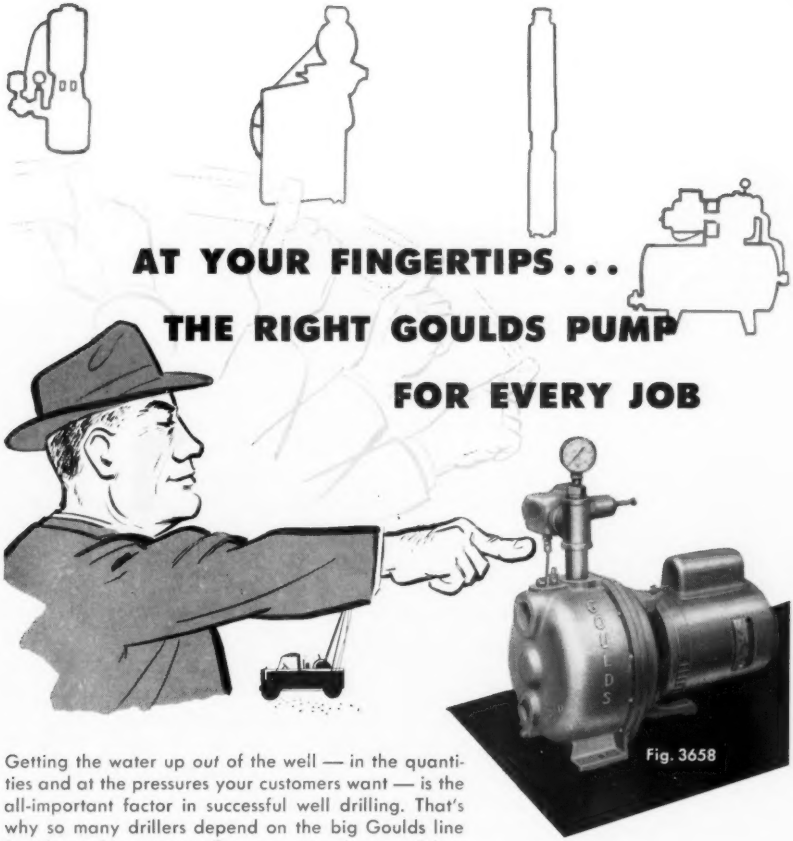
## Pitless Adapter Has Mechanical Seal

A pitless adapter which according to the manufacturer eliminates threading, welding or caulking has been announced by the Williams Products Co., Joliet, Ill.

The essential parts of the adapter are a cast iron housing sealed to the well casing below frost depth, and a removable connector casting from which the drop pipes are suspended in the well.

The unit has a mechanical seal which protects from seepage and contamination. The seal is accomplished by means of a tapered connector which wedges against the casing and the outlet pipe.

The adapter is designed for use with both jet and submersible pumps and



# AT YOUR FINGERTIPS . . .
# THE RIGHT GOULDS PUMP
# FOR EVERY JOB

Fig. 3658

Getting the water up *out* of the well — in the quantities and at the pressures your customers want — is the all-important factor in successful well drilling. That's why so many drillers depend on the big Goulds line for the *right* pump to fit every pumping condition.

For any depth . . . any capacity . . . any pressure — it's easy to select the Goulds Pump that will handle the job best. And — whichever Goulds Pump you install — famous Goulds quality and dependability are *built in* for years of trouble-free service.

That means *greater* customer satisfaction — and greater profits for *you* on every job. See your Goulds Distributor . . . see how Goulds Pumps can make your job *easier!*

**GOULDS PUMPS, INC., Dept. TD-456, SENECA FALLS, N. Y.**

## GOULDS DEEP WELL JET

A completely packaged pump—in ½ H.P. and ¾ H.P. sizes—for low cost installation where pumping levels do not exceed 150 feet. Capacities up to 670 G.P.H. Famous Goulds features at a very popular price.

**You get more with**

**GOULDS WATER SYSTEMS**
Since 1848
FOR EVERY FARM AND HOME NEED

features easy installation and accessibility for pump repair work. For complete information, write Williams Products Co., P.O. Box 1181, Joliet, Ill.

## From the State Associations

**Connecticut**

The Connecticut Water Well Drillers Association held its annual meeting in Hartford Jan. 26. Officers elected to head the organization for 1956 were Frank C. Bacon, Brookfield, president; Winthrop Phelps, Bantan, treasurer; and Gene Bronzi, Torrington, secretary. Eight vice-presidents were elected to represent their counties on the executive board. They are Edmund Glidden of Hartford, Sam Kaplan of Windham, Ed Gaines of Tolland, Edmund Trudelle of New London, Harry Kordick of New Haven, Harry Wilklow of Litchfield, Ernest Rizzo of Middlesex, and Ted Roupp of Fairfield.

**Montana**

The Montana Water Well Drillers Association held its 11th annual convention March 8 and 9 at the Rainbow Hotel in Great Falls. Approximately 60 drillers and suppliers attended. Officers and directors elected were Bob Simpson, Malta, president; George Singley, Lewistown, vice-president; and Homer McClarity, secretary-treasurer. Directors elected were Joe Kirkulidt, Clyde Sando, Norman Ray, and O. A. Kittleson.

"Your first Job?"

**Nebraska**

More than 250 people registered at the 25th annual Nebraska Well Drillers Association convention which was held at the Rainbow hotel in Lincoln Feb. 23 and 24.

State Sen. Don Thompson, the main speaker, told the drillers that Nebraska has the greatest ground water supply of any of the 17 states which is under Bureau of Reclamation development.

At a panel discussion, Dr. E. C. Reed, head of the University of Nebraska conservation and survey division, told drillers to make better use of geology in the drilling of water wells.

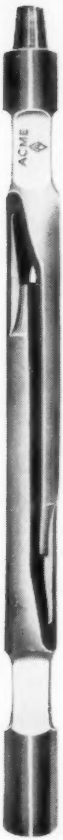
Arthur Haggard, Ogalla, was elected president of the association; Harold Elijah, North Bend, vice-president; Andrew Olson, Oakland, treasurer; and V. H. Dreezen, Lincoln, secretary.

**New York**

The annual meeting of the Empire State Water Well Driller's Association was held at the Mark Twain hotel in Elmira Jan. 28.

Robert McLean, Germantown, was elected president of the organization; Allen Goold, Chatham Center, vice-president; and Robert Klindt, Morris, secretary-treasurer. Directors elected were Don Rigby, C. W. McLoed, Richard Johnson, Theodore Hall,

# Greatest Name in Cable Tools




Acme

TRUSTWORTHY SINCE 1900

## Acme Alloy Jars

Backed by Acme's 54 years experience as manufacturers of highest quality cable tools, the Acme Alloy Rein Type Drilling Jars are designed, forged, heat treated and finished to give maximum strength and to withstand the shock of constant jarring without fatigue failure, and most important, to give extra wear to establish jar drilling records surpassing any now on record.

Acme Alloy Rein Type Drilling Jars are made for water well drillers to API specifications in the following sizes:

5½" Dia. with 3¾" API Joints
4¾" Dia. with 3¼" API Joints
4⅜" Dia. with 3" API Joints
3⅝" Dia. with 2⅝" API Joints
3¼" Dia. with 2¼" API Joints

**Order through your local supply company**

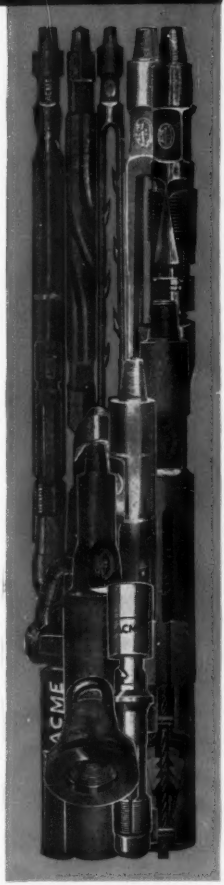



Fig. 107AA Acme Alloy Drill Jars

Write for free copy 36-page (1956 edition) Catalog and tool-use Manual — designed and packed with especially valuable information for Water Well Drillers.

**To-be-Sure —Always: Order Acme's**

You get more of EVERYTHING needed in Acme Tools—100 are shown in new Catalog.

## Acme Fishing Tool Co.

**PARKERSBURG, W. VA.**

**EXPORT OFFICE:**
**Stardrill-Keystone Co., Beaver Falls, Pa.**

ACME DRILLING & FISHING TOOLS Since 1900

Harold Montague and Robert Empke.

**North Carolina**

A "well drillers jubilee" will be held for members of the North Carolina Well Drillers Association at Carolina Beach May 10-12. This was decided at a meeting of the association's directors held Feb. 18. A banquet, prizes and deep sea fishing are scheduled for the three-day gathering.

**Oklahoma**

The Oklahoma Water Well Drillers Association elected H. V. Hueppelsheuser, Enid, president at a meeting held Feb. 13 in Stillwater. Gene Hopping, Oklahoma City, was named vice-president, and O. S. Murphy, Enid, secretary-treasurer.

Glen Lon, Woodward; Emil Grod, Taloga; and J. E. Stamper, Pryor, were elected to the board of directors.

**Southern California**

The Southern California Water Development Association, at a meeting held Jan. 26, elected the following officers to head its organization for 1956: W. D. Bostwick, El Cajon, president; R. E. Anderson, Lakeside, vice-president; J. B. Baker, San Diego, treasurer; and J. W. Parker, Lemon Grove, secretary.

## Poor Ground-Water Supply In North Dakota Area

Ground-water resources in a 72-square-mile area of Mountrail County, northwestern North Dakota, are described in a report released by the Geological Survey.

Ground-water resources generally are either in short supply or of poor quality throughout the area of study. At present the most critical need is in the eastern part of the area, for the city of Stanley, a community with a population of about 1,500.

The study indicates that moderate quantities of ground water of reasonably good quality are available at shallow depths from deposits of sand and gravel in the valley of the Little Knife River about two miles south of Stanley. Geologic and hydrologic conditions appear to favor infiltration and recharge of the aquifer with surface water from the Little Knife River if large withdrawals should be made. These deposits at the present time are virtually untapped.

Ground water, in quantities up to 100 gpm, is probably available throughout most of the area from the Fort Union formation, at depths of 200 to 300 feet. Although the water is soft, the quality is generally poor because of large amounts of dissolved mineral matter. Ground water of variable, but generally poor, quality is also available in small quantities at shallower depths, from the glacial drift which overlies the Fort Union formation.

Entitled "Geology and occurrence of ground water in the Stanley area, Mountrail County, N. Dak.," the report was written by Quentin F. Paulson, geologist with the Survey.

Included in the report are maps and cross sections showing the geology and locations of wells and 46 test holes drilled in the area to depths ranging from 20 to 350 feet. Records of the wells and logs of the test holes are given at the end of the report.

Copies may be consulted in Geological Survey offices at 1242-G General Services Administration Bldg., 18th and F Sts., NW., Washington, D.C., and at the Geology Bldg., University of North Dakota, Grand Forks;

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also, at the North Dakota State Geological Survey, Grand Forks, and the North Dakota State Water Conservation Commission, Capitol Bldg., Bismarck.

## Enormous Water Supply in Ohio Valley Stratum

More than a trillion gallons of water is stored in the sand and gravel fill of the Ohio Valley in Kentucky. This was revealed in a report prepared in co-operation with the Agricultural and Industrial Development Board of Kentucky.

The report describes the old deep bedrock channel of the Ohio River and the alluvial deposits that fill it along the section of the Ohio Valley that borders Kentucky from West Virginia to the Mississippi River. The coarse-grained alluvial deposits, of glacial origin, are permeable and water bearing. The deposits form a ground-water reservoir that ranks as one of the most important in the United States in terms of present use and future potentialities. Because water moves from the river into the alluvium during periods of high river stage and also wherever pumping from wells lowers the adjacent water table below river level, the supply is virtually inexhaustible as long as water flows in the river.

Fine-grained silty material is present near the surface of most of the alluvial fill. At depth the fill is uniformly coarse, however. In the vicinity of Cincinnati, boulders a foot or more in diameter are present in the alluvium, and the average size of material is very coarse. Downstream the average dimension decreases, and at Paducah the largest gravel is about pea size.

The report "The deep channel and the alluvial deposits of the Ohio Valley in Kentucky," will be published as a Survey hydrologic atlas.

Manuscript copies may be examined at the office of the Agricultural and Industrial Development Board of Kentucky, Maps and Minerals Div., New Capitol Annex, Frankfort, Ky.; Geological Survey offices at 830 West Broadway, Room 507, Louisville, Ky.; and Room 1242-G, General Services Administration Bldg., 18th and F Sts., NW, Washington, D. C.

## Wyoming Area Report Issued

Settlers on the Heart Mountain Division of the Shoshone Irrigation Project near Cody, Wyo., are able to obtain ample domestic water supplies from ground-water sources that did not exist prior to irrigation, according to a Geological Survey report.

Prior to irrigation very little ground water could be obtained from either the bedrock or overlying unconsolidated material, and the water available was strongly mineralized. Water of good quality is obtained for irrigation use from the Buffalo Bill reservoir on the Shoshone River west of Cody, Wyo. On the basis of studies by the Geological Survey in 1946, settlers were advised as to the drilling of wells for domestic and stock water supplies. They were assured that, with the beginning of irrigation, generally ample shallow bodies of ground water would be developed in the underlying sand and gravel and that the water would become less and less mineralized as irrigation continued. During 1950 and 1951, data on 134 successful wells was obtained and is included in the report.

The initial study predicted certain

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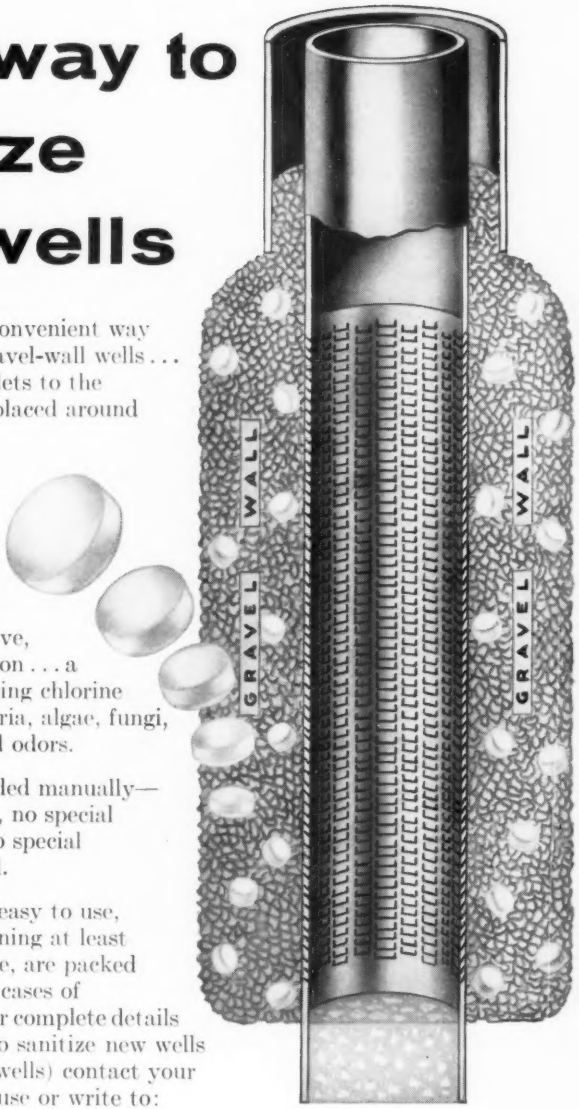


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drainage problems with irrigation, and steps were taken to relieve these problems. Additional studies, made in 1948, 1950, and 1951, confirmed the major conclusions made in 1946 prior to irrigation.

Pending publication, copies of the manuscript may be examined at offices of the Geological Survey, Room 340 Post Office Bldg., Billings, Mont.; 2002 Capitol Ave., Cheyenne, Wyo.; 507 Rudge-Guenzel Bldg., Lincoln, Nebr.; and 1242-G General Services Bldg., 18th and F Sts., NW., Washington, D. C.

## Geological Survey Reports on Alabama Area

A report on the geology and ground-water resources of the Piedmont area, Alabama, has been prepared in co-operation with the Geological Survey of Alabama.

Information contained in the report will aid in the conservation of existing ground-water resources, as well as in the future development of ground water for municipal, industrial, and domestic purposes in an area of about 4,400 square miles in east-central Alabama.

Ground water is obtained from wells that encounter joint systems and solution channels in the igneous and metamorphic rocks underlying the Piedmont. Drilled wells in the area generally range from four to 12 inches in diameter and from about 40 to 600 feet in depth, and yield as much as 250 gpm, although the average yield is less than 40 gpm. The possibility of obtaining an abundant water supply below 300 feet is not good enough to warrant drilling below that depth, according to the report. The most favorable locations for drilling large-capacity wells are in the draws and valleys, where water-bearing fractures and solution channels are most frequently encountered. Small to moderate supplies of ground water of good quality for most private, industrial, and municipal purposes are available, although test drilling is required to locate the waterbearing openings in the consolidated rock. Numerous dug wells 10 to 80 feet deep obtain sufficient water for domestic needs from the weathered shelf overlying consolidated rock.

The report discusses the occurrence, quantity, quality and availability of ground water from each of the water-bearing formations in the area. Tabulated well data include depth, size of casing, water level, chemical character of the water, and other pertinent facts.

Pending publication, the report may be consulted in typewritten form at the Geological Survey Bldg. 6, Smith Woods, University of Alabama, and in Room 1242-G, General Services Administration Bldg., 18th and F Sts., NW., Washington, D. C.

## Florida Aquifer Is Huge Producer

The Biscayne aquifer of southeastern Florida is one of the most highly productive water-bearing formations ever investigated by the Geological Survey.

This aquifer is a wedge-shaped mass of highly permeable limestone and sand, mainly of Pleistocene age, underlain by relatively impermeable marl and clay of late Miocene age. It attains a maximum thickness of about 200 feet in eastern Broward county and about 120 feet in the coastal area of Dade county. It underlies all the coastal areas and most of the Ever-

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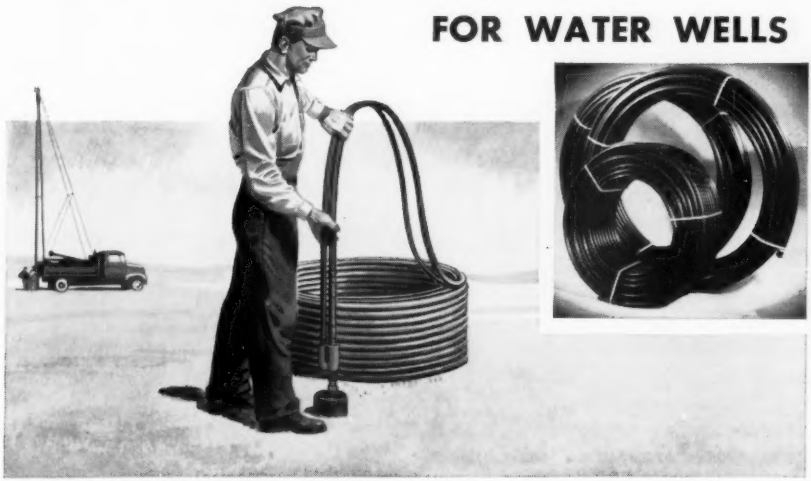

USS NATIONAL Plastic Pipe is manufactured from only pure 100% "on grade" polyethylene raw material. Flexible, light, and easy to use, it can be readily worked into a well. Once in place, NATIONAL Plastic Pipe provides efficient, economical service for years and years.

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In addition, NATIONAL Plastic Pipe imparts no taste or odor to the water passing through it. The smooth interior of the pipe offers very low flow resistance and deters the accumulation of deposits.

USS NATIONAL Plastic Pipe is available in sizes from ½-inch to 6-inches in diameter, in a variety of wall thicknesses. Joints used are of the insert type, quickly secured with stainless steel clamps. *For further information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Specify Bulletin No. 29.*

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UNITED STATES STEEL EXPORT COMPANY, NEW YORK

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glades and is everywhere highly productive. The aquifer is composed predominantly of limestone in the Everglades area of Dade county, but it becomes increasingly sandy toward the coast. It is the sole source of fresh ground water in the area, yielding water that is very hard but of excellent quality for irrigation; with the exception of the hardness, it is of excellent quality also for industrial and municipal use in Miami, Fort Lauderdale, Key West, and many other localities.

Ground water in the Biscayne aquifer occurs under water-table conditions. The water table fluctuates in response to rainfall and is highest during September and October and lowest in spring and early summer. The highest water levels of record occurred in October 1947, after three years of deficient rainfall, and resulted in the accelerated movement of salt water inland along most of the coastal areas of Dade County. Salinity-control dams installed in the major canals of Dade County in 1946 have alleviated the salt-water-encroachment problem in most of the tidal canals.

Very large quantities of fresh water are available in the Biscayne aquifer. It is estimated that 30 million gallons a day was utilized in 1950 in Broward county and about 100 mgd in Dade County. These quantities represent only a small percentage of the potential yield of the aquifer. Withdrawals have increased appreciably since 1950, but the over-all effect on water levels is negligible.

The report contains several geologic cross sections; a series of hydrographs and water-table maps showing highest, lowest, and average ground-water levels of record; illustrations which indicate the extent of salt-water levels of record; and illustrations which indicate the extent of salt-water encroachment in coastal areas and along canals. The report is a result of the accumulation of geologic and ground-water since 1930. Placing particular emphasis on the Biscayne aquifer, it supplements a major report on the over-all water resources of southeastern Florida now in preparation.

Entitled "Biscayne aquifer of Dade and Broward counties, Florida," the report will be published by the Florida Geological Survey. Pending publication, typewritten copies are available for public inspection in offices of the Geological Survey, Room 1242-G, General Services Administration Bldg., 18th and F Sts., N.W., Washington D.C., and Dinner Key, South Bayshore Drive, Miami; and at the Florida Geological Survey, Tallahassee.

## CF&I Expands Plant Facilities

The Colorado Fuel and Iron Corp. plans to spend some $23 million in the fiscal year ending June 30, 1956 on its program of plant modernization and development, it was announced by A. F. Franz, president of CF&I.

"New wire drawing and finishing equipment is now being installed at Buffalo to consume this increased steel production," Mr. Franz said. "The benefits gained from the modernization of the Buffalo plant will also be

*(Continued on page 54)*

*Date Change*

The Virginia Water Well Association convention, originally scheduled for May 25 and 26, will be held May 4 and 5.

# what goes into a successful submersible?...

The three basics of a successful Submersible are the PUMP... the SEAL... and the MOTOR. Byron Jackson is the *only* submersible manufacturer who manufactures all three and combines them in BJ Submersible Pumps... to answer a full range of pumping requirements.

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**the packaged answer to wells 6" and 8" I.D. and larger in capacities from 30 to 260 GPM.**

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The BJ Mechanical Seal is used to prevent water entering the oil-filled motor. This precision seal requires no operating adjustment. It is designed so that it is completely unaffected by sand.

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# from the MAILBAG

This page is open to any of our readers having questions to ask relating to drilling, driving pipe, dressing bits, etc. All letters will be answered promptly by experienced drillers and engineers, who are qualified to give intelligent advice on these subjects. We will publish as many letters of general interest as space will permit. Address: The Driller, South Milwaukee, Wis.

## When to Drill and When to Ream

Dear Sir:

There seems to be a divergence of opinion among my drillers as to the best method to drill large diameter wells.

Let us say, for example, that a 16-in. well is to be drilled. One group of drillers advocates starting the well with a 10- or 12-in. bit, and then reaming it to the desired 16 inches with a larger bit; whereas the other group prefers to start the well with the 16-in. bit and drill it all the way down.

Due to the variation of the formations in this area, I have been unable to obtain good comparisons between the two methods and I would appreciate your expert opinion in this matter.

M.J.S. Mexico

Dear Sir:

There does seem to be a divergence of opinion among some well drillers as to the best method for drilling large diameter holes.

As a general rule, it will take just as much time and cost as much to ream the hole to 16 inches as to drill it 16 inches from the top. When starting a well in a soft formation, it is usually advisable to start the hole full size, say 16 inches and carry this down as far as possible, without reducing, rather than to start a pilot hole, say 10 or 12 inches, and afterwards ream it to the desired 16 inches.

Sometimes, when drilling a large diameter well, 16 inches for example, where hard rock is encountered close to the surface, it may be advisable to start a smaller hole as a pilot and then ream the hole to 16 inches to the desired depth.

The question, "when to drill and when to ream" depends a lot on the formation. There is no definite rule that can be followed in all cases.

Where the holes are relatively large, for instance, 24- to 48-in. diameter, the usual practice is to drill a pilot hole and then ream and re-ream until the desired diameter is reached. For this purpose a special type of fabricated drill bit is recommended.

For example, if the desired hole diameter was 30 inches, the usual practice is to drill a pilot hole about 13 inches and then ream to 30 inches. If the diameter of the hole was 36 inches, the practice is to drill a pilot hole 10 to 13 inches and then ream to 20 inches and re-ream to 36 inches.

In reaming a 10- or 12-in. hole to 14 or 16 inches, a round reamer bit is usally used. A round reamer differs from an ordinary drill bit in that it is made with round body section full length, only slightly smaller than the gauge diameter.

## Rain Makes This Well Muddy

Dear Sir:

About five months ago, we drilled a 3-in. well to a depth of 96 feet.

When we initially drilled the well, the water was clear and good. It is a sand well and we used a screen. However, it has gotten to the point where after a big rainfall,

the water becomes muddy and not fit to drink.

We are not inclined to believe that any water could be seeping down the casing, but rather that a nearby stream, after a big rain, gets into the supply.

May we have your suggestions and recommendations.

J. L. J. Alabama

Dear Sir:

The fact that the water in the well you speak of muddies up only after a hard rain indicates that there might be surface seepage down along the outside of the 3-in. casing; although your thought that a nearby stream affects the supply is also a possibility.

Another explanation is that the casing may have split, or there may be a cracked joint, both of which would permit leakage from the annular space into the well.

We suggest you test the casing for leakage. If the casing is in good condition, the best remedy, as we see it, is to drill the hole deeper and drive the casing into a better sand and gravel bed, or set a liner in cement grout to a suitable depth below the casing pipe terminal.

## How to Drill Through Boulders

Dear Sir:

Could you give us some information concerning a drilling problem we have and your recommendation as to the best method to overcome this difficulty?

We operate a Model 22-W machine and have several prospects for wells to be drilled. The ground formation is filled with what is known in this section as black-iron rock boulders. Our bits hit these boulders, are thrown off to the side of the hole, and bind.

It appears that these boulders are more or less round and so far we have been unable to have any success in getting a well for these people even after trying several different locations.

We are using regular type bits and we

(Continued on page 50)

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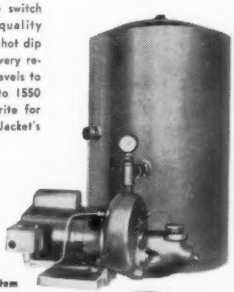

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# *the driller and the* LAW

Articles appearing under this heading are published for their general interest, and to remind readers that it is not safe to overlook the legal aspects of a water well drilling business. The articles are not intended to take the place of specific advice of counsel. For such advice, readers are urged to consult a local attorney.

## It Is Sometimes Wise to Compromise

It often happens that when drilling has "gone haywire" disputes arise between the drilling contractor and the owner as to who is at fault. In such cases, of course, it is desirable, if possible, that the parties settle their dispute and enter into a modified agreement showing the terms of settlement.

Each party should ponder well the possible results of such a new agreement. Usually, a new contract can be drafted which will have the effect of waiving any and all claims previously held by the parties under the old contract; but proper care must be taken in drafting the new instrument.

A case decided April 21, 1953, by the United States Court of Appeals, Fifth Circuit, ought to interest every well contractor. (Texas Water Supply Corp. v. Reconstruction Finance Corp., 204 Fed. 2d 190.) Most of the lengthy opinion is dry reading, but these facts are of special interest, for they were affected by some of the same rules of law which are involved in an ordinary well drilling contract with a private landowner:

The general contractor for construction of a government defense plant in 1942 sublet drilling of two wells to a Texas drilling company.

Four holes were drilled to develop the existence and productivity of water bearing sands. Water was found in Hole #1. Holes #2 and #3 were dry. When Hole #4 reached approximately 514 feet, disputes arose and work stopped.

Approximately one year after the original contract was made, the parties made a new contract, which mentioned the old agreement, the arising of disputes, and stoppage of the work, and provided for the remaining work to be done, such as constructing a foundation for Well #1 and drilling Hole #4 deeper.

The new contract contained this clause: "In consideration of the foregoing each party hereto relinquishes, waives, releases and gives up any and all rights, defenses, forfeitures, claims or breaches which it has heretofore asserted."

It might well pay every drilling contractor to keep this clause in mind when he desires to have a settlement agreement show that he is being released from any possible future claim based on matters arising prior to the new agreement to which he rendered himself liable in damages by failing to comply with the terms of the original contract.

Notice however that the above clause relates only to matters asserted prior to the agreement and says nothing of those that might have been asserted. Also those matters arising

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Pump Shaft is of Stainless Steel. Impeller, Sealing Ring, Jet Nozzle and Jet Tube are of Solid Bronze.

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after the new agreement would likely not be covered.

The Court of Appeals for the Fifth Circuit decided that the quoted clause barred the drilling corporation from afterwards asserting any claim based on matters asserted before the new contract was made. The corporation unsuccessfully contended that the new agreement was unenforceable, because there was no "consideration" — that is, the company got nothing of value — for its release of claims under the original agreement. But, in line with what all courts seem to declare, the Court of Appeals in this one circuit at least has said that the existence of bona fide disputes between the parties under the original agreement, and the mutual releases of claims, was sufficient "consideration" for the releases by each of the other as to all prior asserted claims concerning pre-existing matters.

*—A. L. H. Street*

## MAILBAG

*(Continued from page 47)*

were wondering if a star or four wing pattern bit would work any better for this type of drilling.

W.R.B. North Carolina

Dear Sir:

When drilling ground which contains boulders, particularly large boulders, you have a problem encountered by many a contractor, but to the best of our knowledge, no concrete method of successfully coping with it has ever been worked out. The strategy most commonly employed appears to be to worry the hole down.

As a general rule, small boulders will not give a great deal of trouble, but frequently large boulders must be blasted out of the way.

It occurs to us that the drilling of

a straight hole under conditions such as you mentioned can best be accomplished by employing a "mother hubbard" type of rock bit dressed with a reaming edge of at least 80% and a concave face with the reaming edges extending beyond the cutting or penetrating edge.

The bottom of the bit should somewhat resemble that of a properly sharpened round reamer. It would also be our suggestion that the wearing surfaces of the drilling bit be built up with coarse grade barium. It would have to be put on with a torch. About a 4 in. ring of barium should be built up on top of the bit blade just under the wrench square. This upper reaming ring should be built up to almost the same gauge as the wearing surface, and spiral shaped gaps should be left in the reaming ring so that the cuttings can by-pass. Barium is very abrasive and we believe would go a long way towards keeping the holes straight and to gauge size.

We do not recommend the use of a star or four wing type bit, such as you suggest. This bit is sometimes recommended for broken formations where crevices or seams are encountered and may have a tendency to keep the hole straighter than a conventional type bit.

If a boulder is struck squarely on top, it would be necessary to drill through it to determine its thickness, then split it by the use of dynamite.

In blasting small boulders out of the way, four or five pounds of 40% dynamite placed in the hole opposite the boulder and fired will usually force the boulder far enough out of the way to allow the pipe to pass. In blasting, the pipe or casing must be drawn back four or five feet to prevent it from being damaged.

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# BITS *from the wit sharpener*

Guide: "We are now passing the largest brewery in the state."

Driller in crowd: "Why?"

"I am a mother of four children. My husband wants another one, but I understand every fifth child born in the United States is Chinese. Shall I take a chance?"

Tired and hungry, the itinerant knocked at the door of an English inn called "George and the Dragon."

"Please, mum," he asked the woman who appeared, "could I have a bite to eat?"

"No," she screamed and slammed the door.

He knocked again and pleaded, "But, mum, I've been walking all..."

"I told you 'No'. Now quit bothering me," and she slammed the door again.

Once more he knocked and once more the door was flung open. "Now, mum, could I have a few words with George?"

Wife: "Darling, the maid has burned the eggs. Would you be satisfied with a couple of kisses for breakfast?"

Hubby: "Sure, send her in!"

Mary had a little lamb.
Its fleece was white as snow.
But everywhere that Mary went,
'Twas her calves that stole the show.

Teacher: "Johnny, please tell the class where to find the English Channel."

Johnny: "Sorry, Teach. We don't get that one on our TV Set."

The New York man was telling his friends about a used car he purchased from a friend in Los Angeles that cost him $9,877.

"That much money for a second-hand car?" asked one of listeners skeptically.

"Yeah," replied the man. "The dope sent it air-mail."

First Neighbor: "And where did that naughty little boy of yours get that big gash on his head?"

Second Neighbor: "That little angel of yours hit him with a brick."

Pat sat by his partner who was gasping for breath on his dying bed. Suddenly, the dying man began to speak.

"Pat," he gasped, "I have a confession to make."

"Easy does it old man," Pat comforted the dying partner.

"But I robbed the firm of $10,000. And that's not all, Pat. I sold a secret formula to the competitors, and I stole the letter out of your desk drawer and gave it to your wife so she could get a divorce."

"That's okay, old boy," Pat murmured. "I'm the guy who poisoned you."

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6. Housing
7. Pump pipes
8. Base flange
9. Well casing

THE PATENTED TAPERED CONNECTOR CAN NEVER JAM OR "FREEZE," IS ALWAYS EASILY REMOVED AND RE-SEALED.

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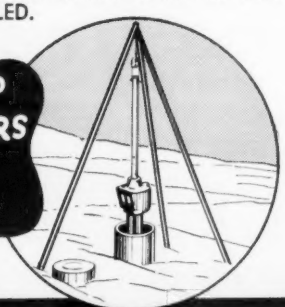


Write today for illustrated literature showing features that make Williams Adapters easy to sell. It's good business to sell the complete job.

**WILLIAMS PRODUCTS CO., DEPT. A, P.O. BOX 1181, JOLIET, ILLINOIS**

## NEWS

*(Continued from page 45)*

reflected in other fabrication plants in the Wickwire Spencer Division, since Buffalo supplies rods and wire to these plants."

At the Palmer (Mass.) plant, which produces wire and wire rope, a large new building is under construction.

At Roebling, numerous projects have been completed and others are now in progress. They include new power facilities, new equipment for the electrical wire and cable department, new wire drawing machines, and other related finishing facilities.

## Carroll

*(Continued from page 19)*

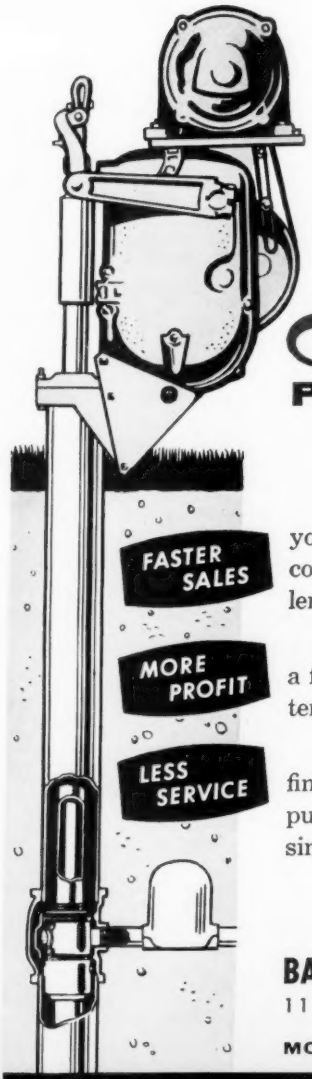
carry the shells and the hole kept falling in. Pumping tests revealed an adequate supply of good water at 100 feet, though, and they finished the well at that level.

Jack Carroll's rotary drilling set-up is a highly mobile one. Not only is the 1-W itself mounted on a Dodge Power Wagon, but the mud "pit" is also portable. To build this piece of equipment, Jack Carroll took a 525-gal. tank and cut it in half lengthwise. He then mounted one-half on an old truck axle with wheels and tires. Next a partial metal bulwark was welded into the trailer-mounted half tank. One side of this bulwark is used as a settling tank. A hitch at the front makes it easy to tow the mobile "pit" from job to job.

The most unusual well the Carrolls put down was an elevator shaft well. The local Elks decided to install an elevator in their 5-story building. They selected a hydraulic elevator because it did not require counterweights and other space-taking machinery. The hydraulic elevator, which is a rarity, is at the top of a long piston or plunger operating in an oil cylinder. Pressure applied to the oil below the plunger raised it and the elevator cab which was at the top.

Carroll landed the job of drilling the 80-ft. well which became the plunger cylinder. The well had to be 16 inches in diameter and perfectly straight so the plunger hung true. The elevator was constructed in a 10-ft. square former stairwell inside the building. To drill, Carroll stationed his cable tool rig on the sidewalk outside the building. Over the stairwell at the fourth-floor level, he set steel beams and installed two sheaves. One sheave carried the tool line down into the stairwell and the other was for the sand line. Carroll ran his lines from the drilling machine's crown sheave, through a window to the stairwell sheaves. With this Rube Goldberg rigging, Carroll drilled the well in a couple of weeks.

Ingeniuty for handling all kinds of drilling jobs in stride has always been a Carroll characteristic.

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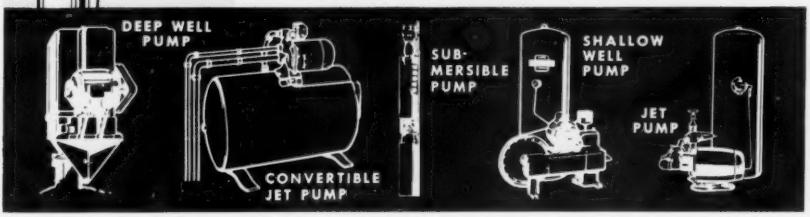

# BARGAIN *counter*

All advertising in this section is payable in advance. Enclose your check or money order with copy. Rate: 60c per line. Minimum charge $2.40. No discounts; no commissions. Count your own copy to avoid delay. The average line contains 28 characters (20 characters if all capital letters are used). Count spaces and punctuation as one character each. Allow 10 characters for box number if blind advertisement is desired. Closing date — 10th of preceding month. Example — January issue closes December 10th. Be sure to address separate inquiries to each advertiser by using the correct box numbers. Mail Box inquiries care of THE DRILLER, South Milwaukee, Wis.

## DRILLS FOR SALE

1954 Bucyrus-Erie 60-L with 1200' of ¾" drill line, 1500' of 7/16" sand line; casing reel line; 4½" x 22' drill stem, swivel rope socket; Price: $9500.

Bucyrus-Erie 22-W drill, mounted on truck.

Bucyrus-Erie 21-W drill, mounted on 1947 Ford truck with string of 6" tools and lines; practically new International engine; newly painted; Price: $1775.

1954 model 50 Keystone, mounted on good 1952 Dodge truck; price including lines, blower and tool guide: $4950. R. R. LONG CO., R. R. 1, Mound Road, Jacksonville, Ill. Phone CHestnut 5-2613.

Two Bucyrus-Erie 27-T Churn drills, used but in good condition; Price #1: $4800; Price #2: $4000.

One Bucyrus-Erie 29-T churn drill in good condition; new in 1951; Price #3: $8800.

Above drills electric motor driven, crawler mounted; large quantity of bits, drilling tools and spare parts; in use until Feb. 1955 when change in drilling method made these surplus; can be inspected at our Quarry in Lowell, Vermont. For further information contact: THE RUBEROID CO., HYDE PARK, VERMONT.

## DRILLS FOR SALE

Two machines patterned after 21-W Bucyrus-Erie; one mounted on Ford truck and the other mounted on Chevrolet truck; both in good condition; Price $950 each. Contact Wershing & Mack, Valley City, Ohio. Phone Valley City 2928 or Brunswick 4793.

Loomis K-2 all steel well drill; Wisconsin motor (4 cylinder); mounted on 1931 Diamond T 1½ ton truck; 275' of ⅝" drill line; 275' of 5/16" sand line; Price $1200. Write or call Bihn's Well Drilling, Raymond Street, Walbridge, Ohio. Phone, Lennox 6949.

#31 Stone mounted on 48 Chev., complete set 6" tools; complete outfit in excellent condition. Price: $3100. E. L. REIDER, Dallastown, Pa. Phone Red Lion 3-6572.

1954 Bucyrus-Erie 20-W mounted on 1948 GMC two-speed rear, telescoping derrick, spooling device, starter, string of 6" tools; all in excellent condition. C. H. Eichelberger, RD #2, Mechanicsburg, Pa. Phone PO 6-6301 after 6 P. M.

Failing model 500 with 600' "N" rod, 750 gal. vacuum lift water tank, tooled for 3" and 4" wells; will consider any reasonable offer. Jake G. Watson, Box 24, Bainbridge Air Base, Georgia.

2 — Model 33-W Bucyrus-Erie drills mounted on good trucks; machines have LeRoi engines and 33' telescoping derricks with rubber shock absorber; each complete with tools and cables ready to go; also spare engine; will sell with or without tools. B. J. Lehrke, 12808 W. National Ave., West Allis, Wis. Phone: SUnset 6-5352.

Number 22-W in first class condition; less than three years old; mounted on 1948 GMC truck, two speed axle; equipped with 600' of cable, sand line and hoisting cable; priced to sell. Wilson and Beemer Supply Co., Albert Lea, Minn.

33-W Bucyrus-Erie mounted on good International truck; in top condition; Price: $3000. Contact Jules Blitz, Napoleon, Ohio.

## DRILLS FOR SALE

1948 Bucyrus-Erie 22-W drill equipped with starter on Hercules six cylinder engine, casing hoist, cat heads, slack line holder, spooling device, power derrick hoist, steel cat walks both sides machine, 500' drill line and sand line; machine and drill engine in A-1 condition; no drill tools; machine mounted on 1946 two-ton International truck, two-speed axle; good tires, truck fair condition; Price: $4850. Poplar Well Drilling Co., Poplar, Wis.

Mayhew "Hurricane" rotary air drill on F-8 Ford truck, two years old, excellent condition. FAYLOR LIME & STONE COMPANY, Winfield (Union Co.), Pa.

1950 Bucyrus-Erie 36-L, tandem float, winch truck, F-8 Ford tractor, steel doghouse, lightplant and top-to-bottom tools. James Smith, Box 33, Mertzon, Texas. Phone 138.

$500 cash will buy Clipper, mounted on Federal truck with 500' of ⅝" and 500' of ¾" line, socket stem, two 6" one 8" bits, set of stem wrenches, two chain tongs, jars, bumper, rolling cutter, bailer. LeRoy Bault, Cloverdale, Ind. Phone 5L9.

Wood frame cable tool machine completely overhauled within last six months with 16 HP LeRoi power unit mounted on 1941 International 1½ ton truck; excellent buy at only $950. Write Dept. W, Box 264, Minneapolis, Minn.

One used Bucyrus-Erie 21-W; late model; excellent condition; price reasonable. Harvey Acker, Rt. 3, Box 287A, Hales Corners, Wis.

Bucyrus-Erie 24-L drill, 42' mast, tool house 6'x6'x6' between the cab and drilling machine, mounted on GMC 6x6 drive, very good rubber; complete string of tools, 4½"x20' stem, 8-6" bits, 2-8" bits, 2¼"x3¼" A.P.I. joints (Spang); new Buda gas engine (extra) if desired. J. C. Rayworth, West Boylston, Mass.; Phone: Temple 5-3428.

## DRILLS FOR SALE

2 Keystone 50s, truck mounted, with or without 6" tools; machines and trucks in very good condition, now working, can be seen anytime. John Coyle & Sons, Hope, R. I.

31 Stone, bought August 15, 1955, mounted on good 1950 Chevrolet truck complete with tools and line; Price: $3000. Contact Robert Mack, Valley City, Ohio. Phone 2928.

21-W drill, 1948 model with catheads, LeRoi power unit, complete with 400' 5/8" and 400' 7/16" cable; machine mounted on 1939 International truck; engine in good condition and good tires on truck. Priced for quick sale $2300.

240 Speed Star 1948 model LeRoi engine, 600' 5/8" and 7/16" cable; mounted on 1945 International truck; $1750. Hadden Well Company, 4441 N. E. Main, Minneapolis, Minn.

#3½ Keystone drill powered with a very good 4 cyl. Waukesha engine; priced at $700. 6" tools and lines also available at extra cost. Alexander W. Blote, 13-14 River Rd., Fairlawn, N. J. Phone: Fairlawn 6-0570.

21-W Bucyrus-Erie drill mounted on 1936 White; excellent condition; complete set of 6" drill tools; $3000 complete; must be seen to be appreciated. George Olwell, 6700 W. Harrison Ave., Milwaukee 14, Wis. Phone LIncoln 1-1770.

1948 Keystone #50 — A-1 condition — tool guide, tool crane, Bucyrus-Erie 22-W shock absorber, 36' telescoping derrick; $2500 less truck. Chas. Rose, Lutsen, Minn.

Mayhew 600 rotary rig capable of going 1000' with 2 3/8" drill pipe, including a 4½-5 Gardner-Denver mud pump; rig is a 1952 model on an L-180 International truck with a 308 engine, new 9.00x20 tires and 2-speed rear end; all in extra good shape and ready to go any place in the U. S.; has 3" Kelly, 100' of 2 3/8" tool joint pipe and all attachments to 10" bit; we would send a man with this rig to instruct your men if desired; price without water truck: $7750. Water truck available, 1½ ton Ford; price: $1000. H. E. Cutter & Dad Drilling Co., 719 E. Pine, Enid, Okla.

## DRILLS FOR SALE

22-W Bucyrus-Erie drill mounted on a 16' semi-trailer with catwalk on each side of drill; trailer has 7.50 x 20 pneumatic dual tires and is equipped with large tool box at front end for carrying hand tools; drill is equipped with rubber cushion sheaves, calf reel, slack line holder, spooling device, tool guide, blower and lines; also available is 1947 Ford tractor with Marmon Harrington drive and the engine is practically new; a 20' Fruehauf flat bed trailer with 7.50 x 20 dual tires is also available; complete outfit as described is in excellent condition and can be purchased for $6000. TWIN STATE WELL CO., Box 62, Bethel, Vermont. Phone 4-4401.

22-W Bucyrus-Erie drill, mounted on 52 Chev. truck; equipped with spooling device, casing reel, cat heads, blower, power derrick hoist, catwalks, 400' drill cable, 400' sand line; truck and drill in good condition; price: $3900. A. B. Dailey, Sweet Valley, Pa.

21-W, truck mounted, cables, tools, ready to go: $1500; 22-W truck mounted, complete, ready to go, 2 years old; 1-W jetting machine, truck mounted, drilled 1 hole; these machines are in top shape so bring your check book and see. C. Enfield, Box 181, Buffalo, Iowa.

1 — 35 Armstrong, all steel; 2 — 45 Armstrong, all steel; 1 — 18 Special Armstrong band wheel type; all four well machines with LeRoi motors, semi-trailer mounted and all in good working condition. Henry Boysen Co., Rt. 1, Libertyville, Ill. Phone LI 2-2559.

29-T Bucyrus-Erie, semi-trailer mounted with tandem axle 8¼-20 tires; power mast, casing line; Buda engine with reverse; first class condition. Price: $8500.

24-W Bucyrus-Erie, good condition with rubber shock mast, power mast; Buda engine, with reverse; electric welder included; mounted on tandem axle truck. Price: $4800.

Armstrong, good condition, rebuilt with power mast, casing line, rubber shock mast; Hercules engine; electric welder; 1940 GMC truck. Price: $2800. WESTERN DRILLING & EQUIP., 1545 Bay St., Tacoma, Wash.

## DRILLS FOR SALE

48-L Bucyrus-Erie spudder complete with all tools from 6" to 10" hole; 6000' of 9/16" sand line, 5000' of 7/8" drilling line; best of condition; machine has made only 10,000' of hole and is 2 years old. Wm. Albers, Box 3, Dundee, Mich. Phone: 53.

1 — 1953 Model 55 Star mounted on 1946 1½ ton Chev. truck.

1 — 1953 Model 71 Star mounted on 2½ ton Dodge truck equipped with air brakes. Will sell either machine with or without cable or tools. J. W. Stafford Well Co., Summerfield, N. C. Phone 2181.

One Cyclone 42, mounted on 47 Studebaker Truck with good motor and 2 speed rear axle with fair tires; machine has tool guide, cat head, spooling device, slack line holder, gear reduction on bull reel for pulling casing, etc., casing reel, starter and generator, 300' of new ¾" drill line, 400' of 3/8" new sand line, cat walks and tool box built on. Price: $5000.

#31 Stone mounted on 43 army truck with 2 speed rear axle, truck and machine in good shape, used 18 months. 250' of 5/8" cable, 300' of 3/8" sand line, has generator and starter; also slack line holder, cat walks built on. Price: $3000, Douglas Holzem, 1975 Prairie Ave., Beloit, Wis. Phone EMerson 2-3922.

22-W Bucyrus-Erie, A-1 shape, 1000' drill line, 400' sand line, 150' casing line; on good Intl. truck; with or without tools. Phone Olympic 2-5584, Kenosha, Wis.

1954 model Keystone 50 mounted on 1948 LWB Mack; machine in excellent condition; F-186 Continental motor, stiff legs, complete string 6" tools. Price $5000 for quick sale.

1952 model Keystone 50 mounted on 1940 White COE truck; machine in excellent condition; F-226 Continental motor; complete string 6" tools. Price $4500 for quick sale. For more information contact Edward F. Delaney, Noxon Rd., Poughkeepsie, N. Y. Phone 2431w2.

21-W Bucyrus-Erie well drill, serial #42103, without truck; this has been cleaned thoroughly, repainted and put in good running condition; price, F.O.B. our yard: $1750. Lyons Machinery Co., 904 Broadway, Little Rock, Ark. Phone FRanklin 4-5007.

## DRILLS FOR SALE

24-W Bucyrus-Erie mounted on Army 6x6; machine fully equipped; 650' of lines included; no tools. MATHIES WELL & PUMP CO., INC., Lindenhurst, L. I., N. Y. Phone Lindenhurst 5-2300.

Truck mounted rotaries: Failing 1500, 1000 and 750; Mayhew 1000; Sullivan model 40, 37 and 200-A. Fred Butler, Box 481, Pueblo, Colo.

24-L B-E drill, new 1947; power derrick hoist, tools and cable; good condition. Forest Gas & Oil Co., Forest, Ohio.

## EQUIPMENT WANTED

Bucyrus-Erie 22-W or 71 Speedstar; also tools for 6" to 10" wells; give details. Schwefel Well Drillers, South Byron, Wis.

Failing power breakout table; rotary machine with 2⅜ drill pipe; Failing 750 or similar.

Have new 21-W mast shock absorber rubbers and plates for sale. Elmer Crain, Boyne City, Mich.

## HELP WANTED

Manufacturer's representative, young, for Eastern States; previous sales or experience in drilling industry desirable but not required; give full details: age, education and past experience in first letter. Box 648

Two men needed immediately by water well contractor; must be experienced and used to drilling in rock; pay is good, to $6000 a year. Milan W. Freese, R. R. #1, Marion, Iowa.

Two rock hole drillers. Apply to Artesian Well & Supply Co., 195 Anthony St., East Prov., R. I. Phone East Prov. 1-0198.

Experienced cable tool driller to work on new Bucyrus-Erie drill; work by hour or footage. Lyle Engebretson, Sheldon, Iowa.

Driller with some experience to run 71 Speedstar for general water well drilling; will pay by the foot; if interested, write me at once. Bernard Shultz, Parshall, N. Dakota.

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SAVE MONEY — drill faster with new J & L Plastic kore drilling lines; write today, give sizes, lengths used; largest selection of used cable tools in the east; bits 4" to 16"; we guarantee to save you money. TRI-STATE TOOL, Box 827D, Parkersburg, W. Va.

New and used pipe and casing, 2" to 8"; write for new price list. Thomas H. Scheuren, 933 Fern Ave., Reading, Pa. Phone 41287.

Two 10" bits used on one job 600' deep, one 10" bit gauge, one tool wrench, one drill stem, one set of drill jars, two bailers; tools all fit together; gone out of business; will sell cheap. John Eckel, Coleta, Ill.

Wanted: Angle drive, ratio 1-1 or 1-1½ — 40 or 50 HP.
For Sale: Use deep well turbines 10 to 50 HP. Write your needs. Max Renner Well Co., Inc., 4806 W. Lake St. Minneapolis 16, Minnesota.


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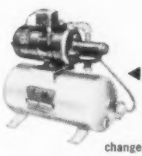

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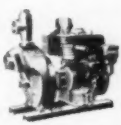

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*The monthly magazine for water well drillers*

South Milwaukee, Wisconsin



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**The 27th annual** Iowa Well Drillers Association convention was held at the Hotel Warden in Fort Dodge Feb. 15 and 16. Officers selected for 1956 are from left, B. L. Zander, secretary-treasurer; Andrew Verwers, vice-president; and Howard M. White, president.


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